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## (54) Radiant panel heater

(57) A radiant heater panel is formed by sandwiching between two pieces (10, 18) of calcium silicate board a heating insert comprising a first sheet of plastics having a thick film of electrically resistive coating applied thereto to form a heating element 12, the element 12 being covered by a further plastics sheet bonded to the first sheet. The heating insert may comprise plastics backed foil sheets 26 applied to either side of the first-mentioned sheets. The heating insert, a terminal structure (14, 15, 20) applied thereto and a power supply lead extending therefrom are placed between the two calcium boards 10, 18 after opposing marginal regions of the boards 10, 18 have been coated with heat-activated adhesive. The boards 10, 18 are then pressed together and the adhesive activated by radio frequency welding to hold the structure together.

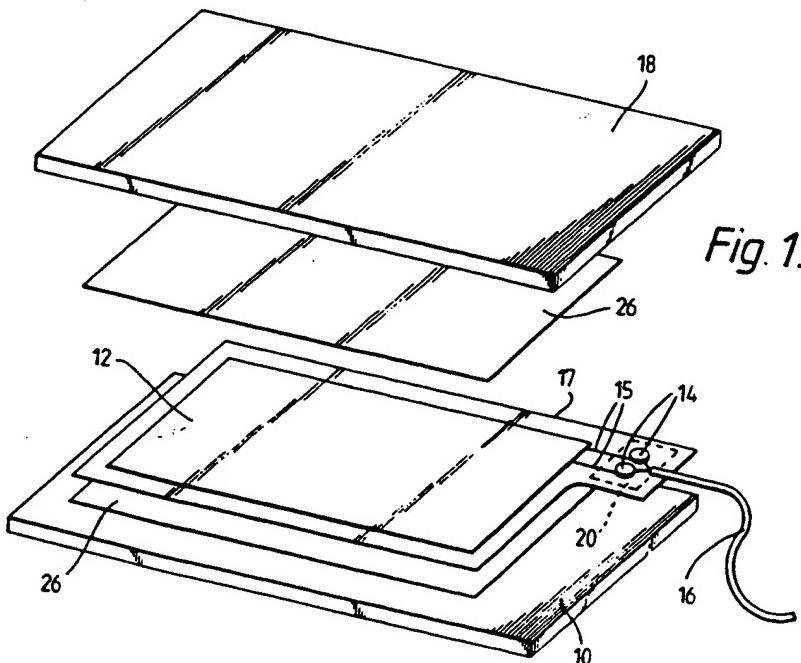


Fig. 1.

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1/4

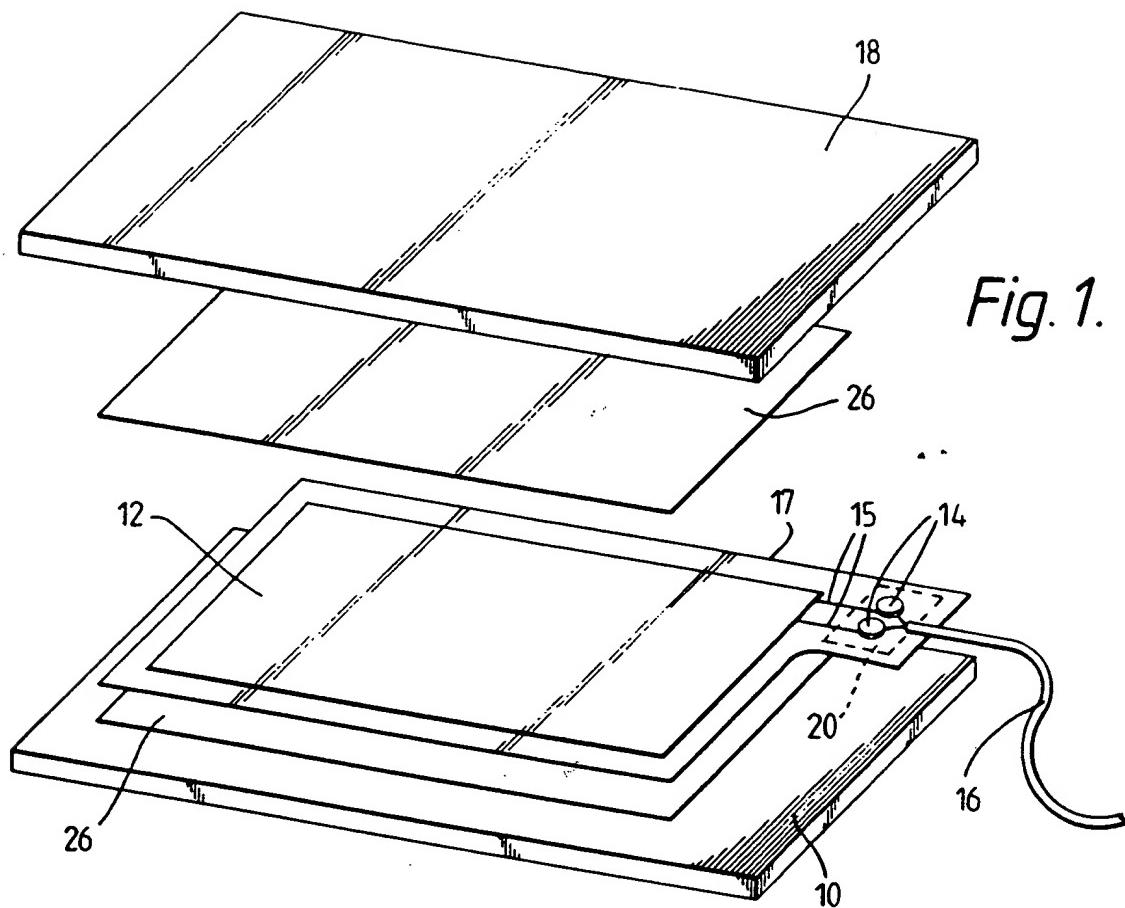
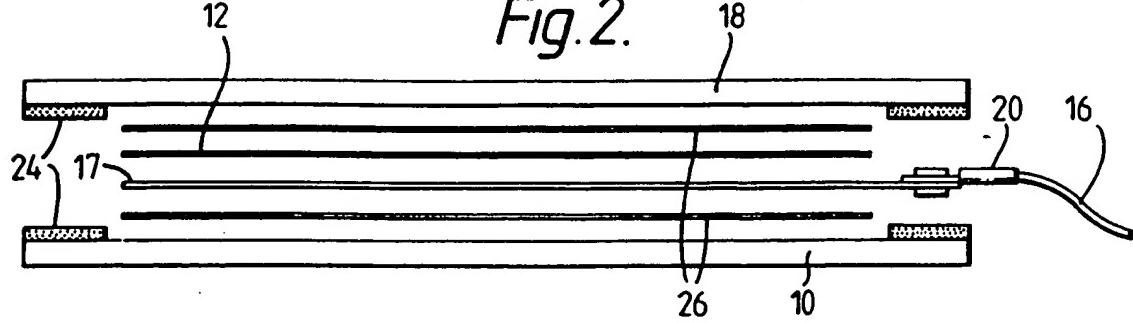
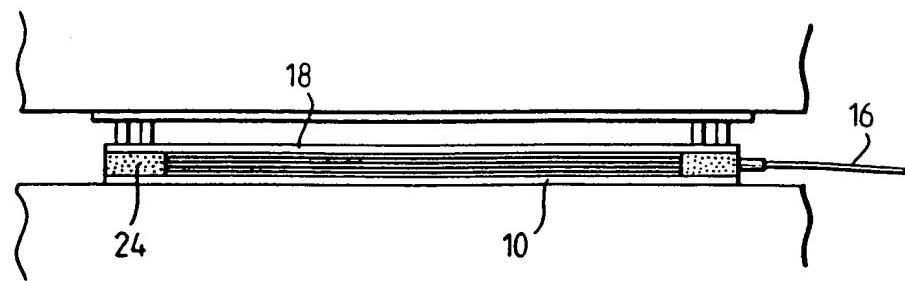


Fig. 2.

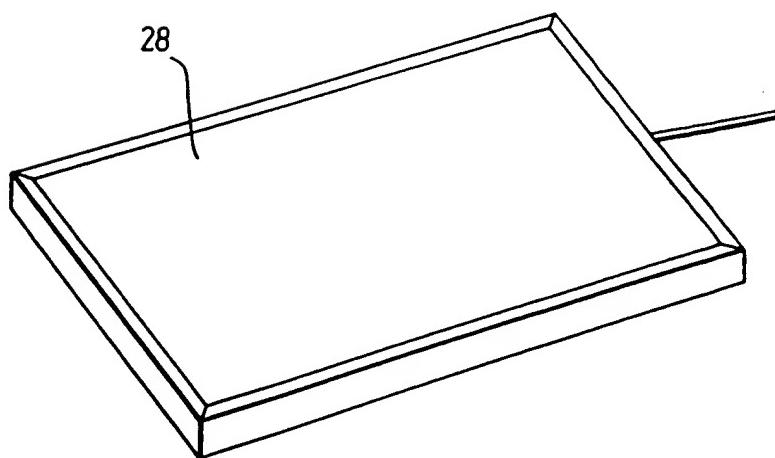


2/4

*Fig. 3.*



*Fig. 4.*



3/4

Fig. 5.

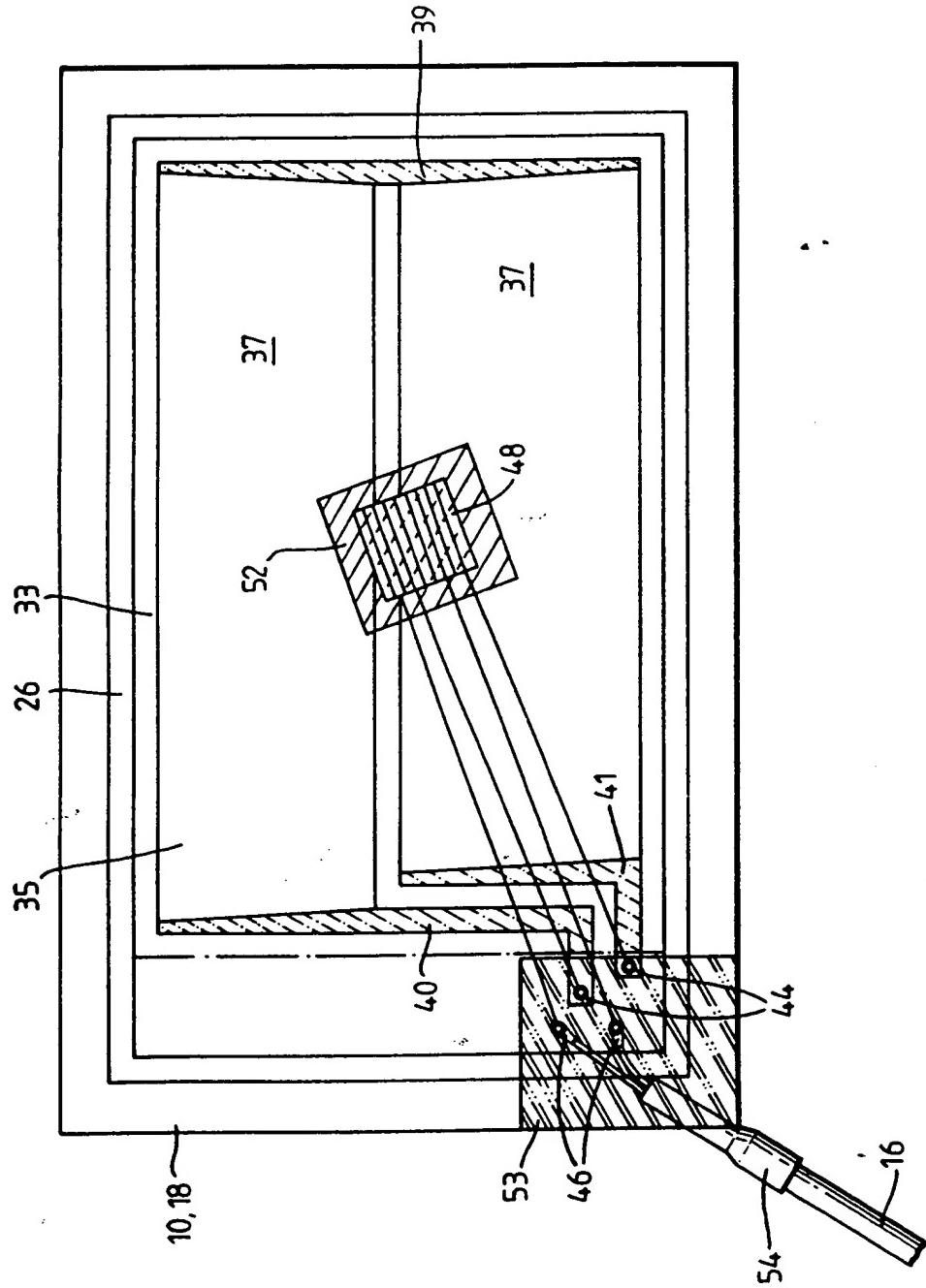
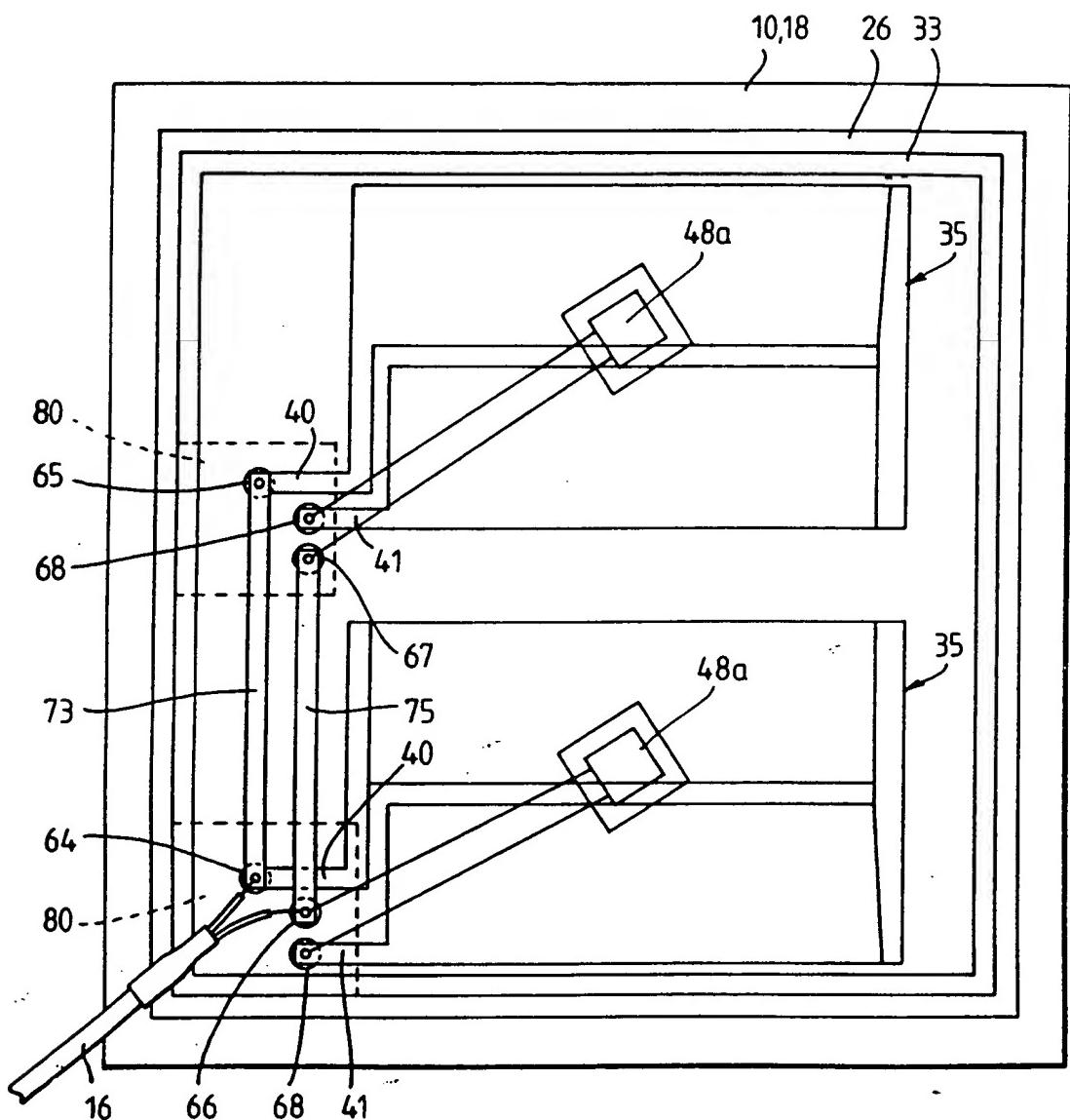


Fig. 6.



## DESCRIPTION OF INVENTION

Title: "Radiant panel heater"

THIS INVENTION relates to an electrically-powered radiant panel heater, for example for domestic heating purposes.

Known radiant panel heaters comprise a resistance heating wire extended in a zig-zag path in a plane, the heating wire being sandwiched between heat-resistant boards which serve to insulate the heating wire and provide physical strength to the structure. However, the manufacture of such panels is difficult and time-consuming, and the resulting panels are thus relatively expensive. Furthermore, such heated panels have, in the past, incorporated asbestos in the boards between which the heating wire is sandwiched. In view of the attendant health hazard, the use of asbestos in a domestic environment is, of course, undesirable.

It is an object of the present invention to provide an improved radiant panel heater and method of manufacturing the same which is more economical and more environmentally acceptable than hitherto.

According to one aspect of the invention there is provided a radiant panel heater incorporating a heating element in the form of a film of electrically resistive material deposited on an insulating substrate, the electrically resistive film being in turn covered by a further insulating layer.

According to another aspect of the invention there is provided a method of manufacturing a radiant panel heater

comprising providing a sheet of electrically insulating and heat resistant material, depositing thereon a film of electrically resistive material and superimposing on said sheet of material, to cover said electrically resistive material, a further layer of heat resistant and electrically insulating material.

Preferably, the sheet material to which said electrically resistive film is applied and the further layer of heat resistant and electrically insulating material applied to said electrically resistive film comprises plastics film and the superimposed plastics films, with the resistive film therebetween, are subsequently sandwiched between rigid heat resistant boards to form the radiant panel heater.

The resistive film is preferably a so-called "thick film" resistive layer deposited, using screen-printing techniques, with a carbon pigmented "ink", the deposited ink being dried or allowed to dry before application of said further layer of heat resistant and electrically insulating material to cover said track.

An embodiment of the invention is described below by way of example with reference to the accompanying drawings, in which:-

FIGURE 1 is an exploded perspective view illustrating a radiant heated panel embodying the invention,

FIGURE 2 is a side elevation view corresponding to Figure 2,

FIGURE 3 is a side elevation view illustrating a stage in the manufacture of the panel, and

FIGURE 4 is a perspective view of the finished heater panel.

Referring to the drawings, a radiant panel heater comprises two rigid rectangular sheets 10 and 18 of calcium silicate board, between which is sandwiched a heating insert 17 comprising a thick film electrically resistive area 12 between two plastics films. The heating insert is formed as follows:-

To one surface of a first sheet of polyester film is applied, by a screen-printing technique, a thick film or deposit 12 of a carbon pigmented ink. After the ink has been deposited, it is caused or allowed to dry, the resulting dry film being electrically resistive so as to be capable of passing current and generating heat when mains voltage is applied via terminal pads 14 and conductive tracks 15 on the polyester film, which tracks 12 extend into the resistive area 12. Respective conductors of a twin-core mains flex 16 are connected mechanically with the pads 14 by means of a coupling 20, known per se, which also provides an electrical connection between the the flex and the tracks 15 on the polyester sheet. A further sheet of polyester film is superimposed on the first-mentioned polyester sheet, to cover the thick film 12 and is heat-sealed to the first-mentioned polyester sheet whereby the resistive thick film is sealed with respect to the environment. The further polyester sheet superimposed on the thick film 12 may also extend over the coupling 20, in which case it may be sealed with respect to the latter. Alternatively, the further polyester sheet may stop just short of the coupling 20, in which case it may be applied over the film 12 before the coupling 20 is applied. The whole is further encapsulated in a barrier film for added insulation and protection.

The heating insert 17 thus formed is somewhat shorter than and narrower than each of the boards 10, 18 so that the insert can be located between the boards 10, 18 with a margin being left all round between the edge of the heating insert 17 and the edges of the boards 10, 18. Prior to

assembly of the panel, a thermoplastic or heat-activated adhesive 24 is applied to the inner surface of each of the boards 10, along the margin referred to. The panel is assembled by placing the heating insert 17 between the two boards 10, 18 with the inner faces of the two boards 10, 18 adjacent the heating insert, so that the heating insert is centrally located and the margin referred to is left clear. Preferably, a respective further sheet 26 of the same dimensions as the heating insert 17, and comprising polyester-backed metal foil, is located between each board 10, 18 and the heating insert 17, again leaving the adhesive-coated marginal regions of the boards 10, 18 clear.

The assembly is then placed in a press, as illustrated in Figure 3 and is pressed together whilst the adhesive 24 on the marginal regions of the boards 10, 18 now in contact with one another, is activated by a radio-frequency welding tool carried by the press upper platen. The heat activated adhesive 24 thus forms a further moisture-proof seal around the panel. After the boards 10, 18 have thus been bonded together the "sandwich" is removed from the press. If desired an edge trim 28, for example of metal, may be applied around the edges of the panel, as illustrated in Figure 4.

Referring to Figure 5, a variant and preferred form of heated panel is illustrated schematically, in plan, from above, (assuming the heater to be in the orientation shown in Figure 1). For purposes of illustration, in the plan view of Figure 5, the various components are shown in phantom. Thus, references 10, 18, denote the two outer calcium silicate boards (shown as one since they are aligned), reference numeral 26 denotes the two foil sheets, again shown as one since they are fully aligned, and

reference 33 denotes the two polyester sheets between which the heating element is located. In this embodiment, as in that described above, the heating element, referenced 35, is in the form of a thick film-resistive coating on the upper surface of the lower polyester sheet 33, with the other polyester sheet 33 being laid over the element 35. The heating element 35 comprises two generally rectangular resistive heating areas 37 connected at their one ends by a more conductive "bus" region 39 and each connected at its other end, via a respective further "bus" region 40, 41, with a respective ring-crimped terminal or eyelet 44 secured to the superimposed polyester sheets 33, in the region of one corner of the heating insert. The power lead 16 has its live and neutral conductors respectively connected to further ring crimp terminals or eyelets 46 secured to the superimposed polyester sheets 33 at locations spaced from the terminals 44 but in the same corner region of the insert. Each of the terminals 46 is connected with a respective one of the terminals 44 via a respective conductive section of a flat cut-out device 48 which overlies the uppermost polyester sheet 33 in the central region of the heater insert and is secured thereto by a patch 52 of adhesive insulating tape applied over the cut-out device, the patch 52 also serving to insulate the cut-out device 48 with respect to the exterior. The terminals 46, 44 and the adjoining portions of the power lead and tracks 40, 41, are covered, on each side of the heating insert, by patches 53 of adhesive glass cloth. The reference 54 denotes a plastics sleeve heat-shrunk over a portion of the power lead 16 adjacent the end thereof, covering the end of the outer insulation of the lead 16 and the adjoining parts of the insulated inner conductors. The respective patch 53 also extends over an end part of this sleeve.

It will be appreciated from the above, that the two parts of the cut out device 48, and the two heating areas 37 of the heater element are connected, in series, between the "live" and "neutral" conductors of the power lead 16. The function of the cut-out device 48 is equivalent to that of a two-pole switch. The cut out serves to prevent overheating of the heater, by breaking the connections between the terminals 46 and the terminals 44 when the temperature of the panel rises above a predetermined level. The cut outs are self-resetting, i.e. if the panel temperature rises above the predetermined level, the cut out operates to prevent current flow until the temperature drops to a safe level, at which the cut out again permits current flow, and so on. In other respects the heater of Figure 5 and the manner of making the same may be the same as that described with reference to Figures 1 to 4.

Figure 6 illustrates a variant of the heater of Figure 5 in which two separate heating elements 35, each of substantially the same form as that in the embodiment of Figure 5, are provided, each connected in series with a respective cut-out device 48a similar to the cut out 48 of Figure 5 (but somewhat simpler in form, being equivalent in function to a single-pole switch). Each heating element 35, with its respective cut-out 48a, forms a respective heater branch, the two heater branches being connected in parallel with one another across ring crimp terminals, referenced 64, 66, connected with the live and neutral conductors respectively of the power lead 16. As in the embodiment of Figure 5, the terminals to which the conductors of the power supply lead are attached are located in one corner region of the heater insert.

In this embodiment, one power supply conductor of the power supply lead 16 is connected directly, via the

terminal 64, with the conductive portion 40 of the heater element 35 nearer said one corner region and is connected with the conductor portion 40 of the other heating element by way of an adhesive copper tape 73 and a further ring crimp terminal 65, the copper tape being adhered to the upper surface of the uppermost polyester sheet 33. The other power supply conductor of the power supply lead is connected to a ring crimp terminal 66 secured to the polyester sheets 33, in said one corner region of the heater insert, whilst a further ring crimp terminal 67 adjacent the conductive portion 41 of the heater element 35 further from said one corner region is connected with the terminal 66 by a further strip 75 of adhesive copper foil stuck to the upper surface of the uppermost polyester sheet 33. The conductive portion 41 of each element 35 is connected electrically with a respective ring crimp terminal 66, 67 secured to the polyester sheets.

Each cut-out 48a is connected between the ring crimp terminal 68 of its associated element 35 and the adjacent terminal 66 or 67 by a respective pair of conductor leads overlying the upper polyester sheet 33. As in the embodiment of Figure 5, each cut-out 48a is secured to the upper surface of the upper sheet 33 by a respective patch of adhesive insulating tape. The assembly of terminals adjoining each heater element and the adjoining conductor portions and portions of copper strips 73 are covered, on each side of the heater insert, by respective patches 80 of adhesive glass cloth applied to the outer faces of the sheets 33. The patches 80 are indicated by broken lines in Figure 6. The portions of the copper strips 73, 75 extending between the glass cloth patches 80 are covered by strips of adhesive insulating tape (which, for the sake of clarity are not shown) applied to the strips 73, 75 and to the upper surface of the upper sheet

33. Apart from the differences specified, the heater panel of Figure 6 and the manner of making the same are as described with reference to Figure 5.

The materials of the various plastics films used in the heater insert may be varied. Thus, for example, polypropylene film may be used instead of polyester. Additional layers of electrically insulating plastics or other sheet materials may also be used. The foil sheets 26 may be bonded together, around their edges, with the remainder of the heating insert sandwiched therebetween, before the resulting package is sandwiched between the outer calcium silicate boards. Thus, the structure of the heating insert may be as follows:-

Encapsulated element/polypropylene/foil envelope/polyester or 10 micron propaply (polypropylene) 75/100 micron polypropylene.

It will be understood, however, that many other variations are possible within the scope of the appended claims.

CLAIMS

1. A radiant panel heater incorporating a heating element in the form of a film of electrically resistive material deposited on an insulating substrate, the electrically resistive film being in turn covered by a further insulating layer.
2. A method of manufacturing a radiant panel heater comprising providing a sheet of rigid, electrically insulating and heat resistant material, depositing thereon a film of electrically resistive material and applying to said film a further layer of heat resistant and electrically insulating material.
3. A radiant panel heater substantially as hereinbefore described with reference to and as shown in the accompanying drawings.
4. A method of manufacturing a radiant panel heater substantially as hereinbefore described with reference to the accompanying drawings.
5. Any novel feature or combination of features described herein.

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